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The investigation of CO_2 storage potential in the Zululand Basin in South Africa

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Abstract

As an emerging country, South Africa is heavily reliant on fossil fuels, resulting in significant CO_2 emissions. As with all countries, South Africa will require a portfolio of technologies to reduce its CO_2 emissions, with carbon capture and storage (CCS) likely to be a particularly important part of this portfolio. There is however, significant uncertainty around the technical potential of CCS in South Africa, as very little data are available for this technology, particularly with respect to CO_2 storage. South Africa has no oil production and very little terrestrial gas production, and as a result there has been no substantial oil/gas exploration onshore since the 1970's. To better understand the technical potential of CCS in South Africa, as well as addressing the uncertainty around CO_2 storage, the South African government, with the assistance from international governments and local and international industry, established the South African Centre of Carbon Capture and Storage (SACCCS). An Atlas on Geological Storage of Carbon Dioxide in South Africa (Atlas) was published in 2010, concluding that South Africa has 150 Gt of theoretical CO_2 storage capacity, 98% of which is offshore. The onshore storage capacity is split between the Algoa and Zululand sedimentary basins, with some additional storage potential in conjunction with enhanced coal bed methane.

The Zululand basin forms a potential onshore target for CCS in South Africa, located on the east coast of South Africa in the northern KwaZulu-Natal Province. The basin represents an onshore extension of the southern Mozambique Basin, with basin-fill sediments of late Barremian to late Maastrichtian age. Basin-fill lithologies are subdivided into three formations, the Makatini, Mzinene and St Lucia Formations. Two sandstone packages of specific interest for CO_2 storage have been identified with the lowermost Aptian-aged sandstone forming part of the Makatini Formation, and the upper Cenomanian to Turonian-aged sandstone occurring along the contact between the Mzinene and St Lucia Formations.

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The Aptian-age sandstone succession is identified at depths between 1200-1800 m extending over an area of ~1680 km^2. It occurs as a 100-250 m thick, interbedded succession of sandstone and siltstone, with subordinate claystone. Sandstone porosities range from 8-18% but permeabilities are extremely low. The stratigraphically higher Cenomanian to Turonian-age sandstone succession is developed as a 20 to 200 m thick package of interbedded sandstone and siltstone, with ~30 m of laterally extensive, clean, gritty, quartz sandstone. The succession occurs at depths ranging from 900 m to <50 m with a consistent south-westward up-dip profile. Porosities range of 15-25% with an average permeability of 229 mD.

In 2013, SACCCS assembled the PCSP Advisory Committee (PAC) to provide external technical input and review to the development of the PCSP. For the first meeting of the PAC, they were asked, based on the basin-scale assessments of the Zululand and Algoa basins, to advise on the likelihood that SACCCS will be able to identify a site for the storage of 10-50,000t CO_2. The PAC in their review report, complemented the depth of work done on the Zululand however recommended that more information could yet be extracted from the existing data prior to deciding whether or not to progress to the acquisition of new geological data, especially given the costs associated with such data acquisition. SACCCS is now working to address these recommendations and will make use of support committed from the World Bank for their completion.

Keywords: CO_2; CCS; South Africa; SACCCS; Council for Geoscience

1. Introduction

Approximately 90% of primary energy in South Africa is derived from fossil fuels, with coal providing 92% of electricity production, whilst 30% of the petroleum used in South Africa is through synthetic fuel production [1]. This energy mix results in significant CO_2 emissions. South Africa is aware however, of the need to address these emissions in order to mitigate their impact on climate change. In 2009, at the Copenhagen climate change negotiations, South Africa pledged voluntarily that, with financial and technological support from developed countries, it would be able to reduce emissions by 34% below business as usual by 2020 and 42% by 2025. As with all countries, South Africa will require a portfolio of technologies to reduce its CO_2 emissions however, with a heavily coal based economy, carbon capture and storage (CCS) is likely to be a particularly important part of this portfolio. To better understand the technical potential of CCS in South Africa, the South African government, with the assistance from international governments and local and international industry, established the South African Centre of Carbon Capture and Storage (SACCCS) in 2009. SACCCS was mandated by its members and the South African Department of Energy to explore the technical potential for CCS in South Africa. SACCCS developed the South African CCS Roadmap, which was subsequently endorsed by the South African Government.

SACCCS's role in the South African CCS Roadmap milestones is as follows:

2004	Assessment of the potential for CCS in South Africa
2010	Development of a South African CO_2 Geological Storage Atlas
2017	Commencement of a Pilot CO_2 Storage Project (10,000 - 50,000t CO_2 stored)
2020	Facilitate the commencement of a CCS demonstration plant (in the order of 100,000t CO_2/year)
2025+	Inform the implementation of commercial CCS deployment (over 1,000,000t CO_2/year)
Ongoing	Provide support to other CCS activities in South Africa

The mandate includes the development of a country-scale CO_2 storage Atlas [2] which defined the countries CO_2 storage potential in subsurface geological reservoirs. Results from the Atlas indicate that South Africa's ~150 Mt of theoretical CO_2 storage potential occurs within Mesozoic sedimentary basins along the continental shelves and coastlines, with 98% of the storage capacity in offshore basins, whilst the remainder occurs in onshore sedimentary basins and deep "unmineable" coal seams (Figure 1). Due to the lack of offshore oil and gas infrastructure and increased cost of initial offshore injection as well as the specific aims of the Pilot CO_2 Storage Project (PCSP), onshore basins were identified for further basin-scale research to define the potential for the project. Two onshore basins were identified, namely the Zululand Basin in northern KwaZulu-Natal and the Algoa Basin in the Eastern Cape Province. A basin-scale assessment of the onshore Zululand Basin was undertaken by the Council for Geoscience (CGS) and Petroleum Agency South Africa (PASA) on behalf of SACCCS. This basin-scale assessment of the Zululand Basin was completed in 2012. In 2013 a team constituting of four international experts with CCS experience making up the PCSP Advisory Committee (PAC) reviewed the reports. Recommendations made for both reports now direct the main focus of SACCCS. This paper discusses the results and recommendations from the basin-scale assessment, the recommendations from the PAC review, and the subsequent SACCCS actions.

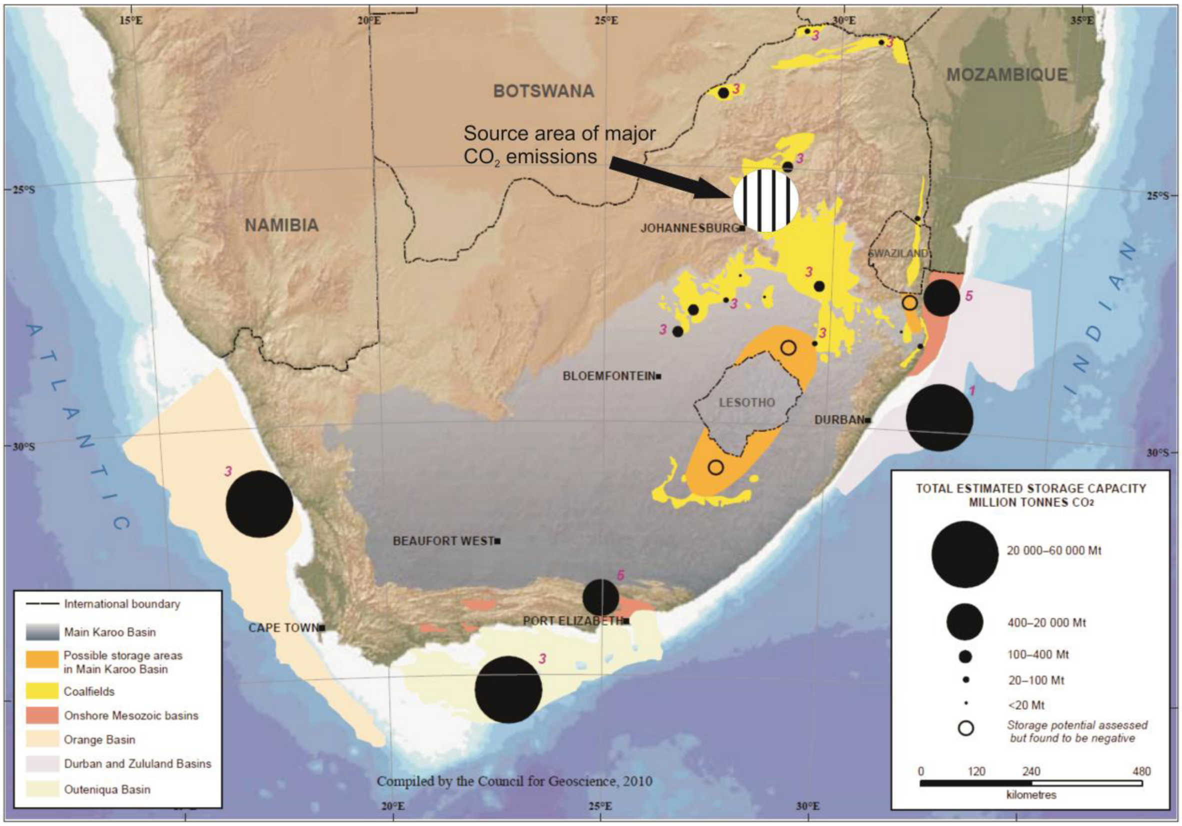

Figure 1: Possible storage opportunities within deep saline formations in South Africa. Data confidence ranked out of 5 is represented by purple figures in each basin. [modified after 3].

2. Basin-Scale Assessment Methodology

The onshore Zululand Basin was the focus of hydrocarbon exploration programmes between 1964 and 1978. Exploration for oil and gas began with acquisition of 2D seismic data by the national oil company SOEKOR. The basin is traversed by approximately 1500 km of 2D seismic profiles which were acquired by dynamite source. At the time of report, only TIFF format and paper copies were available, however the Petroleum Agency South Africa (PASA) has subsequently completed a digitizing program with the data now available in SEGY format.

The ten onshore wells intersecting the late Jurassic to Cretaceous deposits in the Zululand Basin were drilled to depths of between 571 m and 6083 m. Well completion reports, engineering reports, lithology logs and log analysis reports reside in the libraries of the CGS and PASA. Initial exploration was conducted by the Zululand Oil Prospecting Company (ZOE) and Anglo Vaal who drilled four full core boreholes which are housed in the CGS core library in Pretoria. SOEKOR subsequently conducted a basin-wide evaluation drilling six wells between 1971 and 1978. Despite showing good oil and gas reservoir characteristics, the boreholes drilled into stratigraphic traps did not yield hydrocarbons.

For this project, lithostratigraphic analysis was conducted utilizing all available borehole data and a representative selection of seismic data. Due to poor seismic resolution, sandstone units <30 m thick could not be delineated. Therefore, sandstone packages below 800 m depth were considered based upon a cut-off ratio of 50% sandstone [3] (Table 1). The ratio functions as an average ratio for sandstone packages not considering thin lenses within a larger package. The borehole logs were converted into Excel format and then re-digitized in the Golden Software program, Strater. Log compilation served to define the thickness of the sandstone units in each borehole and identify the existence of any impervious mudstone seals above and below the reservoir units. Existing paper cross-sections that accompanied the well completion reports were scanned and digitized in CorelDraw to define the correlation of sandstone packages between neighboring boreholes. Digitized borehole logs created in Strater were then overlain onto the interpretive cross-sections to define the accuracy of the data. The well logs produced were exported as TIFF images and overlain onto selected scanned seismic sections. Selected seismic sections were chosen to try and correlate marker and reservoir horizons between boreholes both down dip and along strike.

Table 1: Cut-off ratios for sandstone, siltstone and shale lithologies logged in the Zululand Basin [after 3].

Sandstone %	Siltstone %	Shale %	Final Lithology
50	40	10	Sandstone
30	60	10	Siltstone
0	10	90	Shale

The extent of seismic reflectors for the lower (Aptian) sandstones and the middle (Cenomanian) sandstones identified in borehole logs were mapped by hand on the seismic profiles. Twenty-five intersecting seismic profiles were chosen and the two-way time of each sandstone reflector was measured at all shot points on the profiles. The two-way time data from each shot point was then transferred onto a transparent overlay on a seismic base map for the Zululand Basin. Contour lines were created at 0.1 second intervals. The final two-way time contour maps were scanned as TIFF images and imported into ArcGIS 9.3 where they were georeferenced and digitized.

The fine-grained, interbedded nature of the sandstone and mudstone units did not allow for precise correlation of reflecting horizons between boreholes, however, by using the SOEKOR well correlation diagrams drawn for all the boreholes, a basic assessment of reservoir extension was possible. By using a combination of seismic sections and well correlation graphs, both down-dip and strike-parallel correlative cross-sections were drawn through the Zululand Basin. Control sections were defined by the intersection of boreholes with a seismic section, as well as the associated correlation graph. Sections that did not contain any borehole intersections were extrapolated using the closest borehole as a reference. The cross-sections indicating the possible reservoirs were then combined with the Excel spreadsheet data from the ten boreholes and were imported into the Surpac 3D modeling program of the CGS regional office in Bellville, South Africa. A 3D model of the Zululand Basin indicating the possible reservoir rocks was created and used to define the volume of each reservoir.

3. Basin-Scale Assessment Results

Three stacked sandstone packages were identified within the northern Kosi Trough with one package identified in the southern St Lucia Trough. Within the Kosi Trough in the northern portion of the Zululand Basin, only the lower and middle sandstone units were deep enough for probable use as CO_2 storage sites. These sandstone units were targeted by the investigation and are discussed in this paper.

3.1. Geological setting and lithostratigraphy of the Zululand Basin

The Zululand Basin is located to the north of the KwaZulu-Natal Province on the east coast of South Africa near the Mozambique border. The basin forms the southern extension of the large, oil and gas-rich Mozambique Basin, to the north. The northern boundary of the onshore Zululand Basin is not a geological boundary, but rather defined by the political boundary separating South Africa and Mozambique. To the south, the basin appears to be fault-bounded with an arbitrarily defined boundary of 28° 50′ S where the succession is laterally displaced offshore [4]. The western boundary is marked by the Lebombo mountain range whilst the eastern boundary extends offshore beneath the continental shelf, giving the onshore extension an aerial extent of 7500 km^2 [4].

The onshore basin which underlies the Maputaland coastal plain, developed as a result of Gondwana breakup between ~155–135 Ma [5] and is structurally compartmentalized into two sub-basins, the northern Kosi Trough and southern St Lucia Trough, separated by a northeast trending basement horst, the Bumbeni Ridge (Figure 2). The eastern margin abuts the Lebombo mountain foothills which form a monoclinic ridge. The eastward-dipping strata on the northern KwaZulu-Natal coastal hinterland are intensively faulted with numerous small normal faults (Fig. 2) relating to the Gondwana rifting event. There is no evidence of faulting affecting strata younger than the Albian.

Basin-fill is dominated by the Late Jurassic to Cretaceous Zululand Group, which is subdivided into three formations, the Makatini, Mzinene and St Lucia Formations (Figure 2). The basal Makatini Formation deposited during the Barremian and early Aptian, comprises conglomerate, sandstone, siltstone and minor limestone, attaining a formation thickness of up to 80 m. Conglomerates occur primarily along the basin edge, deposited as alluvial piedmont fans, whilst distal sandstone units deposited within the deeper portions of the Kosi Trough display evidence of shallow-marine to tidal flat deposition. Distal sandstone facies are generally medium- to fine-grained with planar and trough cross-bedding.

The early Albian to late Cenomanian Mzinene Formation comprises shallow-marine, richly fossiliferous, glauconitic siltstones and fine-grained sandstones [6]. At surface, a major mid-Cretaceous hiatus separates the Mzinene Formation from the overlying late Cretaceous, St Lucia Formation [6], however at depth in the distal portion of the basin, McMillian [7] identified intervals of late Cenomanian and early Turonian lithologies along the contact between the Mzinene and overlying St Lucia Formation.

The St Lucia Formation comprises buff and greenish grey, richly fossiliferous glauconitic siltstone and fine-grained sandstone with interbedded large calcareous concretions. The succession, which is lithologically similar to Mzinene Formation, represents renewed transgression across the Zululand Basin. Although being of Coniacian to Maastrichtian age at surface, in the distal portions of the basin, thick Turonian sandstones are identified, deposited as a shelf-wide forced regressive shoreline deposit of gritty to pebbly clean sandstone. It is likely that the onshore deposits represented in the Zululand Basin extend offshore as the Lower Cretaceous Makatini and Mzinene Formations thicken towards the northeast attaining a combined maximum thickness of 722 m, whilst the upper Cretaceous St Lucia Formation attains a maximum thickness of 876 m. Facies change variations are however unknown as the offshore basin has seen only limited exploration with sparse seismic coverage and no drilling.

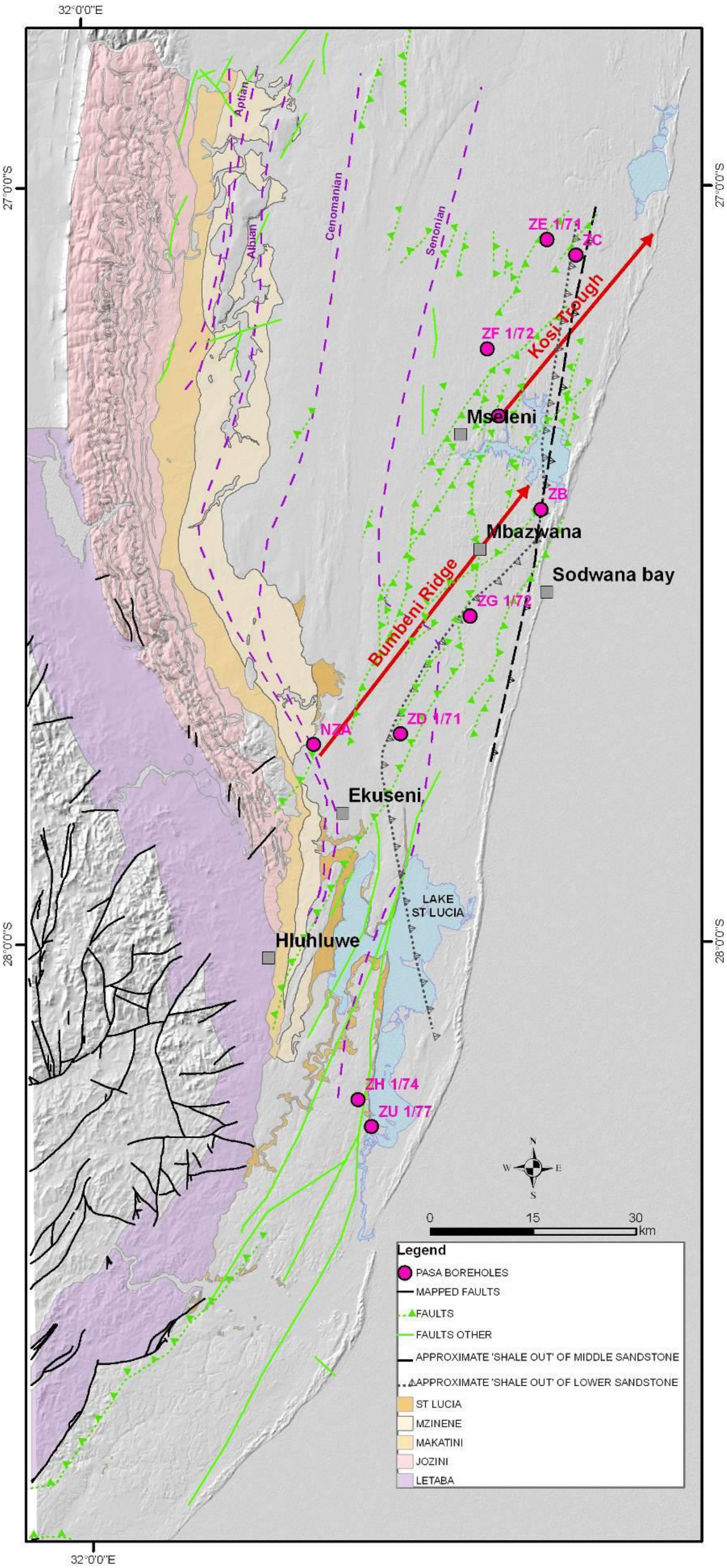

Figure 2: Digital elevation map of the northern KwaZulu-Natal coastal plain underlain by Mesozoic deposits of the Zululand Basin. Outcrop distribution of the Zululand Group formations and the approximate position of the major Cretaceous timelines are shown. The Bumbeni Ridge and Kosi Trough palaeotopographical features and fault lineaments identified from seismic profiles are depicted after [8].

4. Basin-Scale Assessment Discussion

4.1. Storage Potential of the Zululand Basin

Six sandstone packages with varying reservoir properties were identified in the Zululand Basin, however due to depth restrictions for CCS only two were investigated. The basal, Aptian-aged sandstone identified in the Makatini Formation represents the lower potential reservoir whilst a sandstone succession of upper Cenomanian- to Turonian-age represents the uppermost sandstone unit of the Makatini Formation and the lowermost sandstone unit of the St Lucia Formation. Both reservoir packages are well developed at the Kosi Trough.

4.1.1. Aptian Sandstone

The Aptian sandstone succession occurs within the Makatini Formation (Figure 3) and comprises predominantly coarse- to medium-grained sandstone with siltstone and subordinate claystone. Downdip, marine siltstone and shale most likely signifies the first major marine incursion in the Zululand, although lateral facies changes occur as these units interfinger with fluvial deposits towards the basin margin in the west. The Aptian sandstone occurs at depths of 1200 – 1800 m, with a thickness of 100-250 m, and mappable areal extent of ~1680 km^2. The sandstone unit thins out across the Bumbeni Ridge to the south where a ~50 m thick sandstone succession exists in borehole ZB but is absent in borehole ZG 1/72. Sandstone porosities within the succession range from 4-27% however permeabilities are below 1 mD. Cap-rock-seal properties such as porosity and permeability data for the overlying siltstone/shale succession are unknown.

Although numerous inaccuracies were identified due to the lack of specific reservoir data, a static method calculation based upon the CO_2 storage capacity of deep saline aquifers [9] was undertaken to estimate the potential capacity of the Aptian sandstone reservoir. The following formula was utilized or calculation purposes:

$M_{CO2} = A_t \, h_g \, \varphi_{tot} \, \rho \, E$ (see Table 2).

Table 2: Volumetric equation parameters for calculation of CO_2 storage capacity in deep saline formations [9].

Parameter	Units*	Description
M_{CO2}	M	Mass estimate of saline formation CO_2 storage capacity.
A_t	L^2	Geographical area that defines the basin or region being assessed for CO_2 storage calculation.
h_g	L	Gross thickness of saline formations for which CO_2 storage is assessed within the basin or region defined by A.
φ_{tot}	L^3/L^3	Average porosity of entire saline formation over thickness h_g or total porosity of saline formations within each geological unit's gross thickness divided by h_g.
P	M/L^3	Density of CO_2 evaluated at pressure and temperature that represents storage conditions anticipated for a specific geological unit averaged over h_g. See Figure 3.1.
E**	L^3/L^3	CO_2 storage efficiency factor that reflects a fraction of the total pore volume that is filled by CO_2 [Viljoen et al. (2010) stipulates that for South African basins for which net storage areas and thicknesses data are used, this factor should vary from 0,04 to 0,16 for deep saline aquifer storage.]

* L is length; M is mass.

The accuracy of the estimate depends on the amount of data available and additional information will inevitably be required. Although a geometrical factor is used in the formula when storage occurs in a depleted oil and gas reservoir, it is usually not used for storage in saline reservoirs, since it is incorporated in the efficiency factor. Initially, an average efficiency factor is used for the calculations and as more data become available this factor must be refined. The CO_2 trapping mechanism is also an important factor because it influences the storage volume and storage volume assessment method [10]. In saline reservoirs these trapping mechanisms include structural/stratigraphic trapping, hydrodynamic trapping, residual trapping, solubility trapping and mineral trapping [11]. A further important factor to take into account is whether storage occurs in a closed, open or semi-closed system. No refinement of calculations was made in this study to incorporate the different trapping mechanisms, permeability and pressure conditions in the reservoir [12; 13; 10].

Capacity estimates generally have a range of uncertainties and are therefore given as 90%, 50% and 10% probabilities. Due to the uncertainty of the value for the efficiency factor, two scenarios with efficiency factors of 4% and 10% were used. The calculation sheets for the 90% and 50% storage estimations are given in Table 3. Due to the lack of permeability of the Aptian sandstone, a storage capacity based upon an efficiency factor of 1% was calculated and will reduce the estimated CO_2 storage capacity to ~57.2 Mt.

Table 3: Calculation sheet for the Aptian sandstone with efficiency factors of 10% and 4% respectively (saline reservoir storage).

Aquifer properties	**P90 (10%)**	**P50 (10%)**	**P10 (10%)**	**P90 (4%)**	**P50 (4%)**	**P10 (4%)**
Area (m^2)	1,00E+09	1,69E+09	2,84E+09	1,00E+09	1,69E+09	2,84E+09
Net thickness (m)	50	100	200	50	100	200
Avg. porosity (%)	22,30%	22,30%	22,30%	22,30%	22,30%	22,30%
Avg. depth (m)	1,58E+03	1,58E+03	1,58E+03	1,58E+03	1,58E+03	1,58E+03
Avg. geothermal gradient	26,6 °C/km	26,6 °C/km	26,6 °C/km	26,6 °C/km	26,6 °C/km	26,6 °C/km
Avg. surface temperature	25 °C	25 °C	25 °C	25 °C	25 °C	25 °C
Avg. CO_2 density (kg/m^3)	5,13E+02	5,13E+02	5,13E+02	5,13E+02	5,13E+02	5,13E+02
Efficiency factor	0,1	0,1	0,1	0,04	0,04	0,04
CO_2 mass storage estimate (kg)	5,72E+11	1,93E+12	6,49E+12	2,28E+11	7,73E+11	2,59E+12
CO_2 mass storage estimate (million tonnes)	**572**	**1933**	**6498**	**228**	**773**	**2599**

4.1.2. Cenomanian Sandstone

The Cenomanian sandstone which occurs along the boundary of the Mzinene and St Lucia Formations (Figure 3) is made up of two potential sandstone areas; Cenomanian sandstone North (CSN) in the Kosi Trough, and Cenomanian sandstone South (CSS) in the St Lucia Trough. The areal extent for the CSN and CSS is 222 km^2 and 130 km^2 respectively. These two areas are interconnected by a continuous, albeit thin, sandstone unit that drapes across the Bumbeni Ridge. The sandstone in this zone is represented by a succession of interfingering sandstone and siltstone lenses that could be a lateral trap for this unit. To the north, in the Kosi Trough, seismic data suggest that the Cenomanian sandstones wedge out and interfinger with siltstones to the northeast of borehole ZE 1/71. The western margin of this sandstone unit cannot be defined since seismic data for the area around the western edge of the Zululand Basin are not available. It is therefore not known whether this unit comes to surface or whether a lateral trap is present.

The Cenomanian sandstone succession (Figure 3) comprises interbedded sandstone and siltstone, with a ~30 m thick unit of laterally extensive, clean, gritty, quartz sandstone which represents a Turonian-age forced-regressive shoreline deposit that covered most of the late-Cenomanian to early Turonian palaeo-shelf of southern Africa. This sandstone unit forms the largest and most continuous reservoir unit in the Zululand Basin. Porosity of the Cenomanian sandstone unit is estimated from cores and sidewall cuttings to be between 15–35% with a horizontal permeability of 20.2-229 mD and thickness variation of 10–150 m. The unit appears to thin towards the Bumbeni Ridge and from east of borehole ZE 1/71 to borehole C although it does occur at a reduced thickness along the entire extent of the ridge.

As this unit occurs between depths of 23–1,035 m below surface it was not utilized in the initial basin-scale assessment as its depths were deemed to be too shallow for supercritical-state storage. However current analyses suggest that a site for possible continued study occurs in the Kosi Trough where the unit is present below 800 m depth. This northeastern portion of the Cenomanian sandstone appears to be a viable target for continued study (very good permeability and porosities) into the possibility for CO_2 storage as long as adequate lateral and top caps can be found to confine the CO_2 below supercritical depth. Due to the depth factors of the package as a whole, no static modelling was undertaken to define the potential storage capacity of the unit and thus the viability of this sandstone needs to be reviewed.

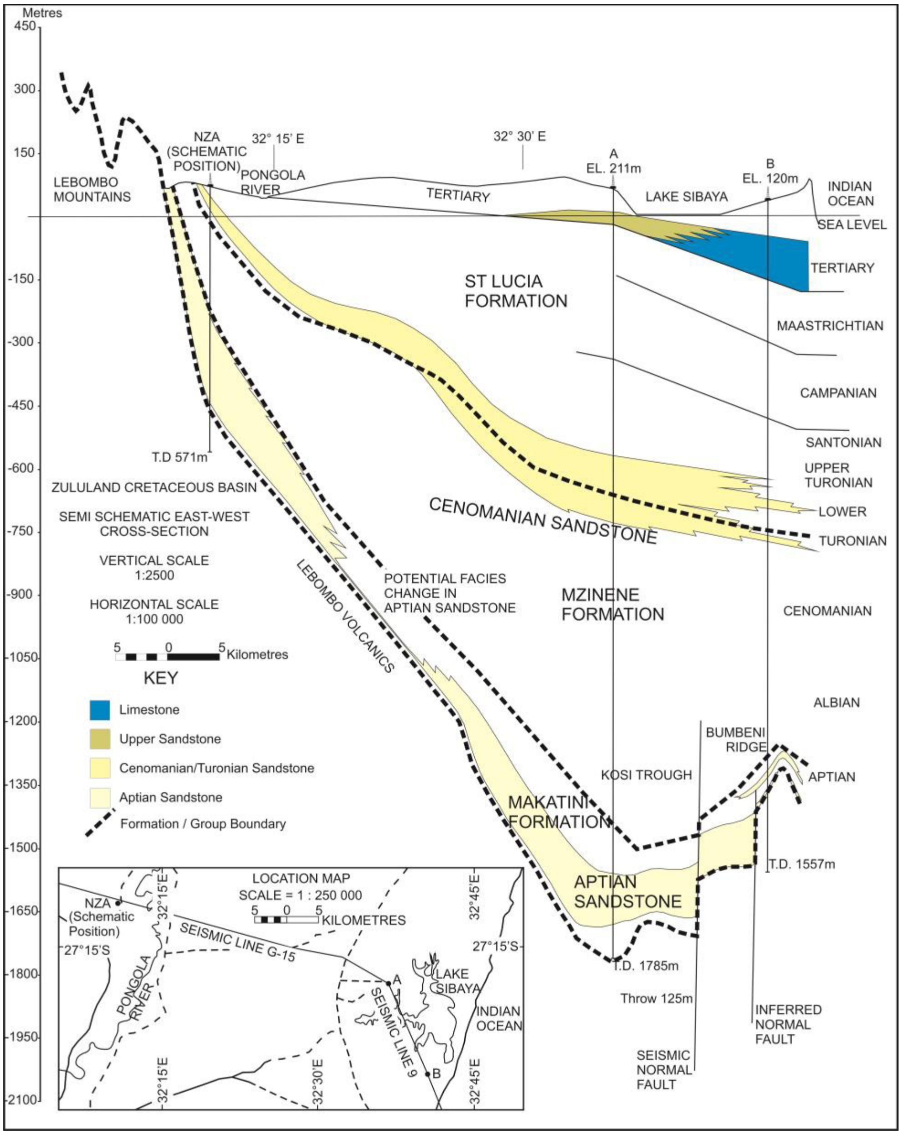

Figure 3: Schematic cross-section of the Zululand Basin from west to east. Sandstone packages are shaded with intervening siltstones not shown. Note the lensing out of the Aptian sandstone across the Bumbeni Ridge to the west. Potential facies change in Aptian Sandstone updip represents change from shallow marine sands identified in borehole intersections, compared with fluvial conglomerate identified at surface.

5. PCSP Advisory Committee Review and Recommendations

In 2013, SACCCS assembled the PCSP Advisory Committee (PAC) to provide external technical input and review to the development of the PCSP. For the first meeting of the PAC, they were asked, based on the basin-scale assessments of the Zululand and Algoa basins, to advise on the likelihood, given the geology of the Zululand and Algoa Basins, that SACCCS will be able to identify a site for the storage of 10-50,000t CO_2, and store this volume over a maximum two year injection program. The PAC were also provided with a number of constraints to be considered including a project budget.

The PAC in their review report, complemented the depth of work done on the Zululand however recommended that more information could yet be extracted from the existing data prior to deciding whether or not to progress to the acquisition of new geological data, especially given the costs associated with such data acquisition.

In particular the PAC recommended that consideration should be given to geology above 800 m as this is a storage efficiency threshold only and safe storage of CO_2 above 800 m is possible. They also recommended that the full newly digitized seismic data set should be reviewed as well as the Zululand core that was not known about at the time of the basin-scale assessment. These new data should then be databased and additional analysis undertaken in the form of static and dynamic models for the formations of interest. This analysis could then be formulated into a play assessment and associated exploration plan which could, together, form a more comprehensive basis for the decision on whether or not to proceed to the acquisition of new geological data

To oversee the implementation of the recommendations put forward by the PAC review, SACCCS has established the PCSP Storage Sub-Committee (PSSC). Actions to address the recommendations are currently underway and will make use of support committed from the World Bank for their completion. A project undertaken by postgraduate students at the University of Johannesburg is currently underway logging and characterizing the available cores housed in the CGS core library. Subsequent to the initial basin-scale report closure, seismic data housed at PASA has been digitized and can be re-evaluated. Research on database and software requirements and options is currently in progress.

6. Conclusions

Lack of available reservoir data is a significant factor leading to uncertainties in the storage potential evaluation for the Zululand Basin. The Aptian sandstone is currently the only reservoir deep enough to for the most efficient storage of CO_2, however is limited by poor permeabilities. Although appearing to show lateral pinchout to the south and east, the western boundary of this unit is unknown due to data limitations. Current estimates at based upon a 4% efficiency factor suggest potential storage capacities between 228–2599 Mt CO_2. Due to the lack of permeability however, storage capacity based upon an efficiency factor of 1% suggest a potential capacity of ~57.2 Mt CO_2. Although occurring at sufficient depth for supercritical phase injection of CO_2, the exceptionally low permeabilities of the unit will likely reduce or even preclude injection potential.

The Cenomanian sandstone although continuous throughout the basin, varies in depth of ~23 m to 1035m below surface. This could impact the efficiency of storage if it was above 800m, with injected CO_2 likely to be in a gas phase rather than the denser supercritical phase. However, the clean nature of the sandstones, and good reservoir properties (permeability >100 mD) make this unit of great interest to SACCCS for further investigation. Although the overlying succession are predominantly siltstone with minor shale, the existence of an effective cap rock above the Cenomanian sandstone has not been tested, and if identified would increase the prospectivity of the unit.

The basin-scale assessment of the onshore Zululand Basin was undertaken with evidence drawn from very limited available data, based on legacy data from the oil and gas exploration of the 1960s with no new testing and analyses undertaken. Therefore the existence of fully cored exploration boreholes, housed in the Council for Geoscience National Core Facility and digitization of seismic data allows for new analysis to be made and could potentially allow for re-interpretation of existing legacy data in accordance with the recommendations of the PAC. There is a need also to give consideration to the geology above 800 m, focusing on the investigation of a seal for the Cenomanian sandstone within the St Lucia Formation. Once this additional analysis is complete, SACCCS will decide whether or not there is a basis to proceed into further exploration of the region with the hope of finding a suitable site for the PCSP.

7. Acknowledgements

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